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INFLUENCE OF TEACHER, PUPIL FACTORS AND THEIR KNOWLEDGE OF STATISTICS ON PUPILS' ACHIEVEMENT IN MATHEMATICS IN OSUN STATE, NIGERIA

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ABSTRACT

The study investigated the influence of teachers' and pupils' factors and their knowledge of statistics on pupils' achievement in mathematics in Osun State, Nigeria. The study adopted the survey design. The input, process and output evaluation model was used. The multistage sampling procedure was used to select 43 public primary schools, 43 primary five teachers and 689 primary 5 pupils. Four instruments, namely Classroom Teaching Observation Scale(r = 0.73), Pupils' Mathematics Achievement Test (r = 0.89), Pupils' Statistics Achievement Test (r = 0.82) and Teachers' Content Knowledge of Statistics questionnaire (r = 0.78) were used. The data were collected from June to July, 2016. Data were analysed using correlation coefficient and multiple regression at $p<0.05$. Findings revealed that pupils statistical knowledge [$\beta = .390$, $t_{688} = 1.655$, $p<.05$], Parents qualification [$\beta = -4.386$, $t_{688} = -2.174$, $p< .05$], classroom management [$\beta = -.292$, $t_{688} = -2.043$, $p <.05$] and lesson preparation [$\beta = -2.695$, $t_{688} = -2,481$, $p<.05$] were most influential in predicting pupils' mathematics achievement. Thus, to improve mathematics achievement, teachers and pupils' statistics knowledge and education should be

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intensified.

INTRODUCTION

Mathematics and statistics play a fundamental role in almost every field of human activity. Over the years, the teaching of statistics at the primary level of education has been incorporated into the mathematics curriculum which is to be executed by teachers who may or may not be specifically trained to teach statistics. There is an increasing recognition that statistics though related to mathematics is a distinct discipline and not a subfield of mathematics. It is imperative that both teachers and learners see statistics and mathematics in the correct perspective to differentiate the features of their logic. Studies on the evaluation of the effectiveness of the primary school mathematics curriculum (statistics inclusive) were mostly in terms of teaching methods employed by the teacher, instructional delivery, enrolment and dropout rates without consideration for both the teachers' and pupils' content knowledge of statistics as embedded in the curriculum.

Mathematics is a tool with which learners obtain knowledge and experience about life. It directs learners' knowledge into real life problems and how to deal with them by improving their ability in logical thinking and reasoning thereby preparing them for their future endeavours. It is well thought-out as the mother of all learning in both arts and sciences and is a prerequisite in pursuing a profession in these disciplines. This perspective on mathematics has gained more attention with the rapid advances in information and communication technology. Mathematics seems not to involve only computation but also is a tool for understanding structures, relationships and patterns to produce solutions for complex real life problems. This makes it necessary for people of all ages to be successful in life.

Statistics has an important role in determining the existing positions of education, per capita income, unemployment, population growth rate, housing in any country; to mention but a few. Statistics are sets of mathematical equations that are used to analyze what is happening in the world around us. When used correctly, statistics tell us any trend in what happened in the past and can be useful in predicting what may happen in the future (eMathZone.com, 2015). Leavy (2010) submitted that the teaching of statistics, as compared to mathematics, has additional considerations when taking into account the type of knowledge needed for teaching it. The knowledge needed to carry out the 'work of statistics' extends beyond concepts, terms, and representations. Statistics did not originate within mathematics and as a result, many of the core statistical ideas are not mathematical in nature. Moore (2004) went further to assert that "statistics, while being a mathematical science, is not a subfield of mathematics".

The reasons for teaching statistics in schools may include the following: it is useful for daily life, has an instrumental role in other disciplines and is important in developing critical reasoning. At the primary school level, statistics is often reduced to frequency counts and bar graphs with rules for calculating mean, median, mode and range added later at the higher classes. Indeed, the mathematics curriculum itself does not give strong and specific emphasis to interpreting, reading, critiquing and questioning data on statistics. It is imperative that learners see statistics and mathematics in a correct perspective to enable them understand the different features of their logic. Pupils of primary schools especially need to acquire statistical skills and knowledge to be able to describe and interpret the world around them. Research has revealed that while pupils are able to perform some statistical calculations, they do not have the ability to inspect them critically (PerelliD'Argenzio et al, 1998).

Academic achievement is usually used in schools to ascertain learners' success in the learning of a given subject curriculum content. According to Adediwura and Tayo (2007), academic achievement is denoted by examination or test scores assigned by subject teachers. Academic achievement remains a burning issue to teachers, pupils, parents or guardians and other educational stakeholders. Poor academic achievement has been a recurrent issue in most school subjects especially mathematics among learners in primary schools (Adesemowo, 2005). Aremu (2000) stated that learners' poor achievement can be wearisome to pupils, teachers and parents, and pupils' are often blamed for their poor achievement (Aremu & Sokan, 2003). The persistent poor achievement of pupils' in the subject as observed from their first school leaving certificate examination results has been cause for concern, yet the way out to this downward trend has become a mirage. This may have been due to many factors among which could be comprehending the statistics component in the mathematics curriculum.

At the primary school level, statistics is usually taught within the mathematics curriculum by teachers who may or may not be specifically trained to teach statistics. Most teachers acknowledge the practical importance of statistics and are willing to give more relevance to the teaching it (Alieme & Osiesi, 2015). However, many mathematics teachers do not consider themselves well prepared to teach statistics nor face their learners' difficulties. Statistics is not just a set of techniques; it is an attitude of mind in approaching data. It enables people to make decisions in the face of uncertainty. The mathematics curriculum should reflect the needs of children to understand their world. Much scientific work deals with gathering, interpreting and predicting from data. This is the essence of statistics. Therefore, statistics education in the 21st century has become increasingly important (Lionel, 2006). There is the need to develop an appreciation of statistics through its applications to the pupils' world. However, the relationship and distinction between statistics and mathematics seems difficult to establish. It is important for teachers to

inculcate the differences outlined by Moore (2004) in children, while teaching statistics at the primary school level.

Teachers play crucial roles in the educational attainment of learners because the teacher is responsible for the translation and implementation of educational policies, curriculum contents, instructional materials as well as assessment of pupils' learning outcomes (Afe, 2003). Teacher qualification include a range of variables affecting teacher quality: type of teaching certification, undergraduate major or minor, advanced degree(s), type of preparatory programme and years of teaching experience. Abe and Adu (2013) restated that teaching qualification is one of a number of academic and professional degrees that enables a person to become a registered teacher in primary or secondary school. Darling-Hammond (2001) reported that teachers with higher educational qualifications tended to promote teaching effectiveness more than those with lower qualifications. Researchers argued that assigning experienced and qualified teachers to low performing schools and learners' is likely to pay off with better performance gaps (Adegbile & Adeyemi, 2008). The above strongly shows that subject matter knowledge (competence), teacher qualification, teachers' years of teaching experience, teacher teaching method, teacher instructional strategy and classroom behaviour are strong variables that could affect learners' achievement.

Marzano (2003) stated that the major independent impact on learners' achievement is instructional strategies and how instructions are delivered. Instructional strategy or learning strategy may be a process by which an instruction module or an entire course is delivered. It takes the form of conference, demonstration, discussion and lecture. In planning instruction for a course, a unit or a lesson, teachers carry out a series of actions based on informed decisions. According to McLeod, Fisher and Hoover (2003), teachers have a sole responsibility to decide how to utilize their resources and choose strategies that will advance their learners to the appropriate level of achievement.

A teacher who has prepared his instructional materials, and established efficient routines should do a "careful analysis of goal and selection of appropriate content for learners" (Eggen & Kauchak, 2001). For planning to be effective during teaching and learning, teachers are expected to incorporate effective classroom management as a process through which they create and maintain an environment conducive for productive learning. This includes teachers' actions that aim at managing learners' behaviour and conducting the business of the classroom, which includes administering corrective measures to students' behaviour and developing ways of preventing occurrence of problems (Taylor, 2009). Effective teaching and learning cannot take place in a classroom that lacks order, hence classroom management and organisation is important because they enhance productive learning (Marzano et al, 2003; Asiyai, 2011). Teachers are expected to take time at the beginning of the academic year, especially on the first day of the school session, to establish classroom

management, routines and expectations for the regulation of learners' behaviour. This will enable the teacher prevent behavioural problems even before they occur and increase instructional time by reducing the time spent on classroom management (Marzano et al, 2003, Marzano, 2010). If proper classroom management is not enhanced, disruptive behaviour by some learners can jeopardize learning as it does not just affect only learners who are noncompliant but other learners' in the classroom.

Pupils' gender can predict pupils' achievement. Boys are likely to be more interested in subjects associated with numbers and are trained to tackle difficult problems unlike their female counterparts. Although boys are generally seen to be stronger physically than girls and so can handle difficult jobs, recent developments have changed such notions since girls are also delving into activities which were previously believed to be for boys, especially in the field of engineering and mechanical works. Unfortunately, gender inequality in education has remained a perennial global problem (Bordo, 2001; UNESCO, 2003; Reid, 2003). The same is true for teachers' gender as pupils seem more open and flexible with teachers of a particular gender, teaching a particular subject at a given time.

The relationship between the socio-economic status (SES) of learners and their academic achievement is well established in sociological research works (Aikens & Barbarin, 2008; Hamid, 2011; Palardy, 2008; Shittu, 2004). According to American Psychological Association (APA), socioeconomic status is commonly conceptualized as the social standing or class of an individual or group and often measured as a combination of education, income and occupation. Parent's educational status, occupation and family size are the socio-economic factors been considered in the study. While there is disagreement over how best to measure SES, most studies indicate that children from low SES families do not perform well as they potentially could have performed when compared with children from high SES families (Considine & Zappala, 2002). The quality of parents and home background of a student also go a long way in predicting their achievement in a subject (Shittu, 2004). Moreover, where the family size is large, parents might find it difficult to provide all the necessary support to the child. The size of the family thus; plays a significant role as regard discipline, provision of necessary materials and emotional support needed by pupils for effective learning. Family size in this context refers to the total number of children in the learners' family in addition to the learner himself. Increase in family size would alter the availability of time and material resources needed by the children of such families. Family size and the position a child occupies in a family may contribute positively or negatively to pupil's academic achievement Oginni (2018). Children may as a result of their birth position, perform more or less in academics (Booth & Kee, 2006). In the same vein, parental occupation may have a positive or negative effect on the general wellbeing and academic achievement of children.

STATEMENT OF THE PROBLEM

The seeming decline in the achievement of pupils in mathematics has raised concerns for stakeholders. The implementation of the curriculum for primary school mathematics with statistics imbedded in it, may have been contributing to poor learners' low achievement in the subject. Consequently, this study evaluated the extent to which pupil and teacher knowledge of statistics hampers pupils' achievement in mathematics.

RESEARCH QUESTIONS

1. To what extent would pupil factors (pupils' statistical knowledge, gender, parents' occupation, parents' qualification, family size and pupils' position in the family) and teacher factors (teachers' statistical knowledge, lesson preparation, classroom management, instructional delivery, qualification and years of teaching experience) influence pupils' achievement in mathematics?
2. Is there any significant relationship in the performance of pupils in statistics and mathematics achievement tests?

METHODOLOGY

The study is a non experimental design of the survey research type. The research type was employed because the researcher had no direct control of the dependent and the independent variables as they had already occurred.

The population for the study comprised of all primary five pupils in public schools in Iwo and Ikire local government areas of Osun State, Nigeria. The public primary schools were chosen to ensure homogeneity of the sample with respect to curriculum content used and school type. Multi-stage sampling technique was used in selecting the required number of respondents for the study. First, two educational zones were purposively selected from the six educational zones in Osun State. Two local government areas of the state were also purposively selected from the educational zone; to ensure that the selected local government areas were not clustered within a zone and prevent contamination. Purposive sampling was used to select forty three public primary schools from the study areas. This is to ensure that schools are far apart in terms of distance in order to avoid undue interaction among the participants of one school and the other. In each school selected, simple random sampling was used to select Primary 5 intact classes. Where only one arm existed, the affected arm was automatically adopted. The class teacher of any class selected and the pupils therein automatically qualified to participate. In all, 43 Primary Five class teachers in the selected schools and 689 pupils constituted the study sample.

Instrumentation

Four instruments were developed by the researchers and adopted in collecting data for the study: Classroom Teaching Observation Scale (CTOS) with Scot's Pi reliability coefficient index of 0.73, Pupils'

Mathematics Achievement Test (PMAT) with Kudar-Richardson KR-20 reliability coefficient of 0.89, Pupils' Statistics Achievement Test (PSAT) with Kudar-Richardson KR-20 reliability coefficient of 0.82, Teachers' Content Knowledge of Statistics Questionnaire (TCKOSQ) with Cronbach Alpha reliability coefficient index of 0.78. The instruments were all developed, pilot tested and validated by the researchers.

The Classroom Teaching Observation Scale (CTOS) consisted of twelve items. The contents of CTOS consist of pedagogical skills displayed by the teacher, teacher classroom organisation and teacher/pupils relationship during teaching. This was placed on 4 point Likert Scale of Poor (1), Fair (2), Good (3) and Excellent (4). The Mathematics Achievement Test (MAT) contained two sections (A & B). Section A was used to capture the demographic data of the respondents with respect to class, age and gender, position in the family, family size. Section B contained questions designed to test the cognitive level of achievement of the learners' mathematics. It consisted of 20 multiple choice test items with four options lettered A to D. Correct response to each of the items attracted a score of 5 while an incorrect response attracted a score of 0. The Statistics Achievement Test (SAT) contained two sections (A & B). Section A was used to capture the bio-data of the respondents with respect to class, age and gender. Section B contained questions on statistics achievement test which was used to test the cognitive level of achievement of the learners. It consisted of 20 multiple choice test items with four option letters A to D. Correct response to each of the items attracts a score of 5 while an incorrect response attracts a score of 0. Teachers' Content Knowledge of Statistics Questionnaire (TCKOSQ) was administered to participating head-teachers of the selected primary schools. It consisted of two sections A and B. Section A solicited information on respondents' personal data such as gender, name of school, qualification and years of teaching experience. Section B contained the questions on the statistics achievement test which was used to test the statistics content knowledge of the teachers. It contained twenty (20) multiple choice test items with four option letters A to D. Correct response to each of the items will attract a score of 5 while an incorrect response will attract a score of 0. Three postgraduate students were trained within three days as research assistants. The researchers and the research assistants administered the instruments to the pupils and teachers in the sampled schools. The classroom observation was carried out by the researchers. Data were collected for six weeks. The data collected were analysed using inferential statistics (multiple linear regression and correlation) at 0.5% level of significance.

RESULTS AND DISCUSSION

Table 1 gives the summary of the inter-correlation matrix of the independent variables (pupils' statistical knowledge, teachers' statistical knowledge, teacher factors and pupil factors) and the dependent variables (pupils achievement in mathematics) under study. The inter-correlation matrix of Pearson-moment correlation coefficients that indicates the

correlation among the predictor variables in predicting the dependent variable (pupils mathematics achievement). Adegoke (2012) emphasised that an inter-correlation matrix is a descriptive statistics table that shows the import of the predictor variables in predicting the dependent variable (also called the criterion variable) along with their means and standard deviations. The essence of the inter-correlation matrix is to determine the degree of tolerance (that is to determine the coefficient of measuring the multicollinearity) among the independent variable in a study. Multicollinearity is detected by examining the tolerance for each independent variable. Tolerance is the amount of variability in one independent variable that is not explained by the other independent variables. This is because none of the values of the correlation coefficients are highly correlated with each other (i.e. $r > 0.75$). The implication of this is that all the predictor variables in the study are good enough to be part of the model in predicting achievement in mathematics. There is a clear indication of non-violation of the major assumptions required for running a regression analysis. Therefore, it is observed from Table 1, that at $p < 0.5$, there is no multicollinearity between or among the variables of study. This concurs with Tabachnick and Fidell (2007) which affirmed that multicollinearity amongst the variables of interest must be resolved before proceeding with regression analysis.

Research Question 1: To what extent would pupil factors (pupils' statistical knowledge, gender, parents' occupation, parents' qualification, family size and pupils' position in the family) and teacher factors (teachers' statistical knowledge, lesson preparation, classroom management, instructional delivery, qualification and years of teaching experience) influence pupils' achievement in mathematics?

Table 2 shows that pupils achievement in mathematics, based on teachers and pupils statistical knowledge and other variables considered in the study, yielded a coefficient of multiple regression (R) = 0.70, a coefficient of determination (R^2) = 0.49 and adjusted R square (R_{adj}) = 0.29.This reveals that the predictor variables jointly explained about 29% of the variance in pupils' achievement in mathematics. Likewise, Table 3 shows that teachers' classroom management skill, teachers' lesson preparation style, pupils' statistical knowledge and parents qualification had a significant influence on pupils' achievement in mathematics, $F_{(12, 30)} = 2.425$; $p<0.05$.

Going by the findings of this study, learners' achievement in mathematics and statistics is related. This implies that learners' knowledge and achievement in mathematics can go a long way in determining his or her knowledge and achievement in statistics. This is in consonance with the Moore (2004); Alieme and Osiesi (2015), who asserts that statistics, while closely related to mathematics, is a distinct discipline. Therefore, a pupil who performs well in statistics will likely have high achievement in mathematics. Teachers' classroom management skill, teachers' lesson preparation style, pupils' statistical knowledge and parents' qualification

significantly influence pupils' achievements in mathematics. This finding is in line with the findings of Eggen & Kauchak (2001) who restated the import of lesson preparation by the teacher as a factor that could foster classroom management, learners' attitude to learning and their overall academic outcomes. The finding of the study also buttresses assertions by Asiyai (2011), Charles (2011), Daly (2005), Marzano et al, (2003), Marzano (2010) and Sowell (2013) that classroom management enhances effective teaching and learning, which in turn gives rise to productive learning outcome.

Research question 2: Is there any significant relationship in the performance of pupils' in statistics and mathematics achievement tests?
Table 4 shows that there is a significant relationship between pupils' achievement in statistics and mathematics achievement tests with a correlation value of r = 0.002. The finding is in tandem with studies conducted by Moore (2004), Leavy (2010), Alieme and Osiesi (2015) which restated the relationship that exists between knowledge of statistics and mathematics achievement among learners. However, the finding negates the findings of Ndukwu (2002) and Adeola (2011) which stated that teachers' qualification significantly influences pupils' intellectual development. It also contradicts Marzano (2003) who found that teachers' instructional delivery has a major independent impact on learners' achievement and opposes claims by Ghanbarzadeh (2001), Scott (2001), Bowen and Richman (2000); that learners' attitude towards a subject is a predictor of their achievement in such a subject. The finding does not give credence to the findings of Popham (2005) and Goodykonntz (2011); that learners' poor attitude towards mathematics could lead to their poor performance in mathematics and statistics. The study shows that parents' qualification has a significant influence on pupils' achievement in mathematics by supporting Phillips (1998) that parental qualification and social economic status have an impact on pupils' achievement. Furthermore, this study revealed that pupils' gender, family size and position in the family do not influence their achievement in mathematics. This is in consonance with Abiam and Odok (2006), Howes (2002) and Sinnes (2005), who noted that there is no significant relationship between gender and mathematics achievement.

CONCLUSION AND RECOMMENDATIONS

This study sought to evaluate the extent to which teachers' and pupils' statistical knowledge, pupil and teacher factors influence pupils' achievement in mathematics in Osun State, Nigeria. Findings show that teachers' classroom management skill, lesson preparation style, pupils' statistical knowledge and parents' qualification significantly influence pupils' achievement in mathematics. Furthermore, the findings show that there is a significant relationship between pupils' achievement in statistics and mathematics. Therefore, efforts geared at improving mathematics achievement, especially at the primary level, should include statistics

knowledge and education in order to enhance pupils' achievement in mathematics. Hence, it is recommended that if Osun State government intends to vigorously improve mathematics achievement among learners, particularly primary school pupils, she should do the following: enlighten parents on the need for a higher educational qualifications and to ensure that pupils view statistics and mathematics in the proper perspective and that teachers are well enlightened on the need for statistics knowledge in mathematics teaching and learning and on the distinction between statistics and mathematics.

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